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PHILOSOPHICAL TRANSACTIONS.

April, 17. 1671:

The CONTENTS.

Extracts of several Letters, containing sundry Inquiries and Experiments about the Bleeding of Trees, especially by the warmth of the Fire; the Circulation of Sap in Trees; the Consistence and Quantity of Sap in the respective parts of a Vegetable; and the Communication of one part of a Plant with another, in relation to the Ascent and Descent of Sap, &c. Some Communications concerning Cyder; and the season of Transplanting. Observations touching Colours, in order to the Increase of Dyes, and the Fixation of Colours. An Accompt of some Books. I. Theodori Kerckringii M. D. ANTHROPOGENIÆ ICHNOGRAPHIA. II. PHILOSOPHIA VETERUM, é mente RENATI DESCARTES breviter digesta ab Antonio le Grand. II. TRAITE DE PHYSIQUE par Jaques Rohault. IV. Novæ Hypotheses de PULMONUM MOTU & RESPIRATIONIS usû Specimen.

Extracts of divers Letters, Written by Martin Lister Esquire, to the Publisher; Touching some Inquiries and Experiments of the Motion of Sap in Trees, and relating to the Question of the Circulation of the same.

I. Januar. 28. 1673. York.

YOU may be pleased to put this *Querie* also, concerning the Bleeding of the *Sycamore*: What condition
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the Soil is of, where such Trees are planted, that shall either bleed, or refuse to do so:

* Of both which, see this *Observer's* Experiments formerly communicated, No. 68. p. 2067, 2608. whether Sandy, as that of *Nottingham*, or a wet Clay, as that of the two Trees, I have observed here at *York*. *

2. Febr. 8. 167 $\frac{1}{2}$. *York*.

Concerning the Bleeding of the *Sycamore*, be pleased that I acquaint you with the following Experiment of very late date. The first instant it froze, the wind at North; the Frost and Wind continued (some little Snow now and then falling) the 2d, 3d, 4th, 5th, 6th, until the 7th in the morning, when the wind came about to the South-East, and the weather broke up a pace, the *Sycamores* bled not all this while; but the seventh about noon, all Trees of that kinde bled very freely both at the Twigs and Body, and I struck above a dozen.

At this same Critical season, I was willing to repeat the Experiment upon other Trees, and to this end I forthwith struck the *Haw-thorn*, *Hazel*, *Wild-Rose*, *Gooseberry-Bush*, *Apple Tree*, *Cherry-Tree*, *Blather-Nut*, *Apricock*, *Cherry-lawrel*, *Vine*, *Wal-nut*; yet none bled but the last nam'd, and that but faintly in comparison of the *Sycamore*. This is consonant to our former Experiments: And if it did hap-

pen, as I said in one of my former Letters *, that these *Sycamores* bled not all this Winter afore at the wounds made the first of *November*, I do now think, that if new wounds had been still made at every breach of Frost, some signes at least of our *York-shire* bleeding *, might have been discovered before now: But I affirm no more than I have seen and tried.

* See No 68. p. 2068.
* See the ground for this distinction in the same Numb. 68. p. 2067, 2068.

In all the Monuments of the Ancients, collected by the great industry of *Pliny*, I finde but few instances of this nature. Amongst those few there is one, that is registred with two or three remarkable circumstances to our purpose. He tells us, that the *Physicians* of old, when they had a mind

a mind to draw the juyce of the *Mulberry-tree*, were wont to strike it skin-deep only, and that about two hours after Sun-rise. This Experiment is twice mention'd by him, and in both places as a strange *Phænomenon*. We might make our Comment upon those places, but for this time are content only to transcribe the Texts. *Lib. 16. cap. 38. Mirum, hic (cortex) in Moro, Medicis succum quærentibus, ferè hæc à diei secundâ, lapide incussus manat, altius fractus siccus videtur.* *Lib. 23. c. 7. Mora in Ægypto & Cypro sui generis, ut diximus, largo succo abundant, summo cortice desquamato; altiore plagâ siccantur, mirabili naturâ.*

3. Febr. 15. 1677. York.

To continue our Experiments concerning the motion of the Sap in Trees; Febr. 11th, all was here cover'd with a white Frost betwixt 9 and 11 in the morning. The weather changing I made the Experiments, which follow, upon the *Sycamore*, *Walnut*, *Maple*. A twig cut asunder would bleed very freely from that part remaining to the Tree; and, for the part separated, it would be altogether dry and shew no signs of moisture, although we held it some pretty time with the cut end downwards; But, if this separated twig was never so little tipp'd with a knife at the other end, it would forthwith shew moisture at both ends. The same day, late in the after-noon, the weather very open and warm, a Twig cut off in like manner as in the morning, would shew no moisture at all from any part. These Experiments we repeated very many times with constant and like success on all the Trees above-mentioned. I enter'd this Experiment with these *Quæries* for the next opportunity. 1. Whether a Twig, or the small part of a Root cut asunder, will not bleed faster, upon the breaking up of a Frost, from the part remaining to the Tree, than from the part separated; and whether the part separated will bleed at all, and shew no more signes of moisture, than a Twig cut from the top of the Tree, unless that small Root be likewise cut off at the other end also? 2. Whether when it shall happen, that a *Sycamore* shall be found to bleed upon the setting in of a great Frost, the top

twigs and small roots will not both of them bleed freelier from the parts separated, in proportion to their bigness? 3. And if it shall not so prove in the Tryal, that in cold weather the Sap moves *inwards* from Root and Branch to the Trunk, and that upon the breaking of a Frost, the Sap moves *outward* from the Trunk to the extremities of both Root and Branch; I say, if this prove not so, whether there be any different motions of Sap at a time in the divers parts of one and the same Tree; and where such motions of Sap begin, and whither they tend? 4 Whether the Sap, when it will run, moves longer in the Branches than in the Roots; or whether it begin not to move in all parts of a Tree at a time, and rest every where at a time? 5. When it rests, whether it retires to the Body of the Tree, from the Roots and Branches, or sinks down to the Root, or is any way spent by insensible steams, or is quiet and lodged in every part of the Tree in proportion?

I shall long to hear the success of your Experiments in the Question of the *Circulation* of the Sap. I have many years been inclin'd to think, that there is some such motion in the Juices of Vegetables. The reasons which induced me, are; 1. Because I finde, that all the Juice of a Plant is not extravasate and loose, and like Water in a Sponge; but that there are apparent Vessels in Plants, analagous to Veins in Animals: which thing is most conspicuous and clear in such Plants, whose Juice is either White or Red, or Saffron-colour'd; for instance, in each kind of Juice we propose *Lactuca*, *Atractilis*, *Chelidonium majus*. 2. Because that there are very many Plants (and these last named are of the number) whose Juice seems never to be at rest, but will spring at all times freely, as the Blood of Animals, upon Incision.

The way of Ligature by Metalline Rings, by you mention'd, is an Expedient I have not used; but other Ligatures I have, upon a great number of our English Plants, not without the discovery of many curious *Phænomena*. The success of an Experiment of this Nature upon *Cataputia minor Lobel*, was as followes: I tied a silk-thread upon
one

one of the Branches of this Plant, as hard as might be, and not break the skin ; there follow'd no greater swelling, that I could discern, on the one side of the silk than on the other ; although in often repeating the Experiment, some silks were left hours and dayes unloosed, and yet the dimple which the thread had made in the yielding branches, had a little raised the immediate sides, but both alike : the Plant in like manner would bleed very freely both above and under the Tye. This was also, I thought, very remarkable, amongst other things, in this Experiment, that in drawing the Rasour round about the branch just above or below the Tye, the Milky Juyce would suddenly spring out of infinite small holes, besides the made orifice, for more than half an inch above and below the Tye : which seems to argue , that though there was no Juyce intercepted in appearance from any turgescence, (as in the process upon the members of a Sanguineous Animal) yet the Veins were so over-thronged and full, that a large orifice was not sufficient to discharge the sudden *impetus* and pressure of a some-ways streighten'd Juyce.

I have endeavour'd many wayes to discover the Configuration of the Veins of Vegetables and their other constituent parts and Texture ; but enough of this in one Letter.

4. *March 17. 1674. York.*

To the end that I might satisfy myself about some of the doubts I sent you, I have been most concern'd, according to former thoughts and inclinations, in examining the Truth of these Quæries, *viz. Whether Saps are not to be found at all seasons of the Year in a much like Consistence and Quantity in the respective parts of a Vegetable ; and what Communication one part of a Plant may have with another in relation to the Ascent and Descent of Sap ?*

Now, because Sap is then said to Ascend from the Root, when it is found to move in Tapping ; I lopp'd off certain Branches of a *Sycamore*, the morning betimes of a hard Frost (*Febr. 21.*) before they would bleed, or shew any signe of moisture. This I did to vary the *Efficient*, not willing to wait the Change of the Weather, and the *Suns* heat;

heat ; but brought them within the Air of the *Fire* : And by and by, as I expected , they bled apace , without being sensibly the warmer.

The Experiment repeated afforded me divers *Phænomena*, which follow ; and proved *almost* an Universal way of Bleeding all sorts of Trees, even those, which of themselves would not shew any signes of moisture.

1. Poles of *Maple*, *Sycamore* and *Walnut*, cut down in open weather, and brought within the warmth of the *Fire*, did bleed in an instant. Also *Willow*, *Hazel*, *Cherry*, *Wood-bind*, *Blather-nut*, *Vine*, *Elder*, *Barbery*, *Apple-tree*, *Ivy*, &c. *Whicking* and *Egge-berry Tree* (i.e. *Padus Theophrasti*) tried in the same manner in *Craven*.

2. *Briar* and *Rasberry-rods* were more obstinate. *Ash* utterly refused, even heated hot.

3. Branches, that is, Poles with their tops entire and uncut , bleed also when brought to the *Fire* side ; but seem not so freely to drink up their Sap again when inverted, as when made Poles.

4. The same *Willow-Poles*, left all night in the grass-spot, and return'd the next day to the *Fire*-side, bleed afresh.

5. *Maple* and *Willow-Poles* bleed and cease at pleasure again and again , if quickly withdrawn and balanced in the hand, and often inverted to hinder the Falling and Expence of Sap : Yet being often heated , they will at length quite cease , though no Sap was at any time sensibly lost. And when they have given over bleeding , that is, shewing any moisture, by being brought within the warmth of the *Fire*, the Bark will yet be found very full of Juicye.

6. An hard Ligation made within a quarter of an inch of the end of a *Wood-bind* rod, did not hinder its bleeding at all when brought within the warmth of the *Fire*.

7. *Maple* and *Willow-Poles*, &c. quite bared of *Bark*, and brought to the *Fire*, will shew no moisture at all in any part.

8. One *Barbery*, or *Pipridge-pole* bared of its *Bark*, brought to the *Fire*, did shew moisture from within the more inward Circles, though not any from the outward.

9. *Maple* and *Willow-poles*, &c. half bared of *Bark*, would bleed

bleed by the Fire, from the half onely of those Circles, which lay under the bark.

10. *Maple* and *Willow-poles*, split in two and planed, would not shew any moisture on the planed sides, but at the ends only.

11. A Pole of *Ivy* did of it self exudate and shew a liquid and yellowish rosin from the bark and near the pith; but when brought to the Fire-side, it bled a dilute, thin and colour-less Sap from the intermediat wood Circles.

12. A Pole of *Willow* (for Example) bent into a bow, will use its Sap freely, as in bleeding either spontaneously or by the Fire.

Extract of a Letter, Written to the Publisher by Francis Willoughby Esq; from his House at Middleton in Warwickshire March 16. 1677. relating to some particulars, above mention'd in M. Lyster's Communications of Feb. 15. 1677.

SIR, My business and want of time to prosecute Experiments, I hope will plead my excuse for not answering yours of *Feb. 18.* sooner. Since that, we have review'd our old notes, and made some few Experiments, and finde, that Branches of *Willow*, *Birch*, and *Sycamore*, cut off and held perpendicularly, will bleed *without tipping*; and that the cutting off of their tops does not sensibly promote the bleeding. We have not yet made trial in *Maple* and *Walnut*, the weather having been such, that those Trees have not run freely since the receipt of your Letter. We doubt not of Mr. *Lyster's* diligence and veracity, and wonder, our Experiments should differ*. The Trials we have made this year, confirm those we communicated to you formerly, *viz.* The *Sycamore*

* See this difference removed below, by M^r. *Lyster* himself.

bleeds upon the first considerable Frost, after the Leaf is fallen, as it did plentifully the 16th of *November* last: And both that, *Walnut* and *Maple* bleed all Winter long after frosts, when the weather relents, and the Sun shines out; but *Walnut* and *Maple* begin not so soon as the *Sycamore*. The *Birch* will not bleed till towards the Spring. This year it began something sooner than ordinary about the beginning of *February*.

We

We cut off pretty big branches of *Birch*, and, having tipp'd the ends, inverted them, and fasten'd a *Limbus* or ring of soft wax to the *great* ends, which we held upwards; making with the plane of the end a Vessel of about an inch deep, where-into we powred water, which in a few minutes sunk into the pores of the wood, and running quite through the length of the branch, dropp'd out of the ends considerably fast, continuing so to do as long as we powr'd on water. The like Experiment we made by fastening such rings of wax to the *lesser* ends, and pouring in water, which run through the wood, and dropp'd out of the greater ends, as fast or faster. This we tried once upon a *Sycamore* without success.

Extract of a Letter of the above-mentioned Mr. Lister, written to the Publisher from York, April 8. 1671. both in relation to the further Discovery of the Motion of Juyces in Vegetables, and removing the difference noted in the next fore-going Letter.

SIR, Yours of the 4th instant came safe to my hands. This last Month hath been a busie time with me in my private concerns, so that I have but a few things to return to what you have been pleased to communicate to me, in relation to the further discovery of the Motion of Juyces in Vegetables. And I must acquaint you, that these Notes following are above 14 dayes old; for I have scarce busied my head, or put my hand to any Experiment of later date.

One or both ends of the pith of a *Willow-pole* seal'd up with hard wax, will yet freely bleed by the warmth of the Fire. This was tried, when the last Experiments, I sent you, were; and were then, I think, omitted.

March 24th. was the greatest Frost and Snow we have had this Winter in these parts about *York*. Some Twigs and Branches of the very same *Willow-tree*, as formerly, and likewise of many other *Willow-trees*, taken off this morning, *March 23th*, when brought within the Air of the Fire, would shew no moisture at all; no not when heated warm, and often and long turn'd.

March 24th, the same *Willow-branches*, which yesterday would not bleed, and were thrown upon the Grass-spot all night

night ; did, both they and others, new cut down by the Fire-side, freely shew moisture and bleed this morning upon the breaking up of the Frost.

Ash-poles and *branches* this day, nor yesterday, would by the Fire be no more moist, than when I formerly tried them.

The same morning *March 23th*, a Twig of *Maple*, which had had the top cut off the 7th of *February* last past, and which then bled, this day being quite taken off from the Tree, and brought within the Air of the Fire, and held with the formerly cut-end downwards, did not run at all at the end, but held on in that posture, it did run apace at the other new-cut end upwards, so as to spring and trickle down.

Note, That this doth well agree with my Experiments made the last year at *Nottingham*, where I observ'd wounds of some months standing to bleed apace at the breaking up of every hard Frost. For *first*, in these parts there hath been no hard Frost this year, not comparable to the last year. *Again*, those *Nottingham-trees* I wounded in the Trunk, and they stood against a Brickwall, and the wounds were on the side next it ; and besides had Horse-dung stopp'd in all of them for some reasons ; which things did undoubtedly defend them much from the Air and Winds, and keep the wounds still green and open : Whereas the tops of these *Maple-twigs*, spoken of in the last Experiment, were expos'd in an open hedge to the Air and Winds ; as also the two *Sycamores* here at *York* mention'd in my former Letter to have been wounded in *November* last, and not to have shew'd any signes of moisture, for that very cause, that they were not fresh struck at Bleeding times.

Concerning the Bleeding of *Poles* and entire Branches held perpendicular, Mr. *Willoughby* is in the right, and some Experiments in my last to you of *March 17th* confirm it. Yet it is very true what I observ'd, though the Cause I did not then well take notice of, when I first made the Experiment and sent you an account of it. For, I held the Twigs, which I had cut off, a slope, joyning and holding up the cuts together in my left hand, that I might the better observe, which part or cut would bleed or not bleed the faster ; and because I found, that the cut of the separated Twig did not in that posture (holding it upwards, as I said, for the advantage of my eye) bleed at all, when as the Cut of the Branch remaining to the Tree did freely bleed ;

I therefore inverted the separated Twig and held it perpendicular with the cut end downward, and found, that that little they were expos'd to the Air in an upright posture, had so very much check'd the motion of the Sap, that I concluded they would not bleed at all; and yet striking off their tops, and making Poles of them, I found some of them, if not all, that I chanc'd to try, as I remember, would shew moisture: But I am convinced since, that it was rather some unheeded accident, as violently bending them, or perhaps the warmth of my hand and season, or place, which caused this new motion of Sap, than merely the striking off their Tops.

Some Communications, about an early Swarm of Bees, as also concerning Cyder; Descent of Sap; the Season of Transplanting Vegetables: Sent to the Publisher out of Herefordshire by that Intelligent Gentleman, Richard Reed Esq; in a Letter dated March 14. 1679. at Lugwardine.

ON Thursday last, the 9th of Instant, there was at the next house to mine a *Swarm of Bees*. It was a very fair day to entice them; but else *we* never have them till the middle of *May*. I had it from the owner, one *Parry*, now in my work, and I enquir'd of him, whether they did not all leave the Hive, as sometimes they do unseasonably, either for want of food, or out of distaste? He told me, no, but there are as many left behind as came forth. But I (who have sometime studied the Regiment of that little industrious wise creature) do conceive, that Poverty drew them abroad to seek their fortunes; the infinite Wisdom having imparted such a Providence to that little Commonwealth, as to send part of their Company abroad to shift, before their whole stock of food shall be consumed, to the destruction of them all, (*Deus Maximus in Minimis.*)

And now to what I formerly promised. I have read that excellent Book of Mr. *Evelyns*; especially his *Pomona*, and have learnt many things out of it, which I before had not observ'd; and particularly the new way of Planting therein mention'd out of the papers of my Ancient and worthy Friend Mr. *John Buckland*, whom I do never remember but with very great respects: As also the New way of making *Pepin-Cyder* by Sir *Paul Neil*, to whom (unknown) I do, and our whole Country ought to return very many thanks. For certainly, the reasons, rendred by him of the harshness and the cure of it in
Pepin-